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(54) EXTRUDED SEALING STRIP

(71) We, SCHLEGEL (UK) LIMITED, a British Company, of Ring Road, Seacroft, Leeds, LS14 1LY, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to sealing strips, formed for example by extrusion, and especially designed for forming a seal against metal surfaces attracted by magnetism, such as between a refrigerator door and the body of the refrigerator. The invention also relates to the method of forming the sealing strip.

One common known seal which is used on refrigerator doors is formed from a rubbery or plastics material which is magnetic in nature and which is adhered either to the refrigerator frame or refrigerator door so that when the door is closed, the seal will be attracted by magnetism to whichever of the frame or door it is not adhesively secured. The seal is given its magnetic properties by incorporating in the plastics or rubbery mix prior to extrusion Barium or Strontium ferrite which is naturally magnetic. This known seal operates very satisfactorily but unfortunately it is expensive to manufacture because Barium and Strontium ferrites are expensive.

Another known magnetic seal is a two part seal, comprising a hollow rubber or plastics extrusion, into which a magnetised strip is then inserted. This is expensive, because of the three manufacturing steps necessary. Furthermore, because of limitations in wall thickness, these known magnetic seals have a gap between the magnetised strip and the sealing surface generally 0.020 inches or greater. Known magnetic technology prefers the lowest possible gap as the magnetic force is reduced exponentially with increasing gap size.

We have now developed a seal suitable for refrigerator doors and many other uses in which we can reduce the wall thickness between the magnetised strip and the surface to zero and which is no more expensive to produce than known seals.

According to the present invention we provide a seal for sealing against a metal surface such as a refrigerator door, the seal being formed of a resiliently deformable preformed polymeric material which carries a magnetised or magnetisable metallic strip at or adjacent one of its surfaces, the resiliently deformable polymeric material being extruded around the preformed strip so as to be integral therewith.

The seal may be of any cross-sectional shape, and in one construction, the seal is of a generally rectangular cross-section and is suitable for a refrigerator door seal. Preferably, the strip is of a ferrous metal which is located just below the surface and generally centrally along one of the longer faces of the seal. In this construction, the opposite face of the seal may be especially formed for connection to a surface, e.g. a refrigerator door or frame; for example, the opposite face may have a generally dove-tailed configuration for mating engagement in a re-entrant groove, for example in the frame or door of a refrigerator. Alternatively, the opposite face may be adapted for adhesively or otherwise securing the seal to the door or frame.

If desired, a further magnetisable metallic strip may be located just below the surface of the opposite face of the seal, said further strip preferably being wider than the first-mentioned strip so that when magnetised it will adhere to the metallic surface of the door or frame with a greater adhesion than the first-mentioned strip. In an alternative construction, the seal comprises a continuously moulded polyurethane foam surrounded by a synthetic film, e.g. of polyethylene, with a magnetic or magnetis-

able strip located immediately within the synthetic film, on a surface of the foam.

5 In a further alternative construction, the seal may be of the type used in the automobile field for sealing around doors in motor vehicles, with the magnetisable or magnetised strip adjacent one face of a rubber extrusion, the opposite face of which is connected to a U-shaped gripper for application to a flange around a door opening or door on the motor vehicle.

10 The present invention also extends to a method of manufacturing a magnetic seal comprising the steps of extruding a resiliently deformable body of polymeric material around a magnetisable metallic strip in such a manner that the metallic strip is located adjacent one peripheral surface of the body, and subsequently magnetising the metallic strip through said polymeric material.

20 The invention is now described by way of example with reference to the accompanying drawings, in which:-

25 Figure 1 is a cross-section through one embodiment of seal, and

Figures 2-5 are cross-sections through four other embodiments of seal.

30 Referring to Figure 1, an extruded refrigerator door seal is illustrated, the seal being formed of an elastomeric or resilient plastics material 3 (which is shown as solid but could be cellular) and being generally of a rectangular configuration. A preformed ferrous metallic strip 5 is located just below the surface of one of the longer faces 7 of the seal, the width of the strip being about one-third of the width of the face 7. The opposite face 9 of the seal is specially formed with a dove-tailed portion 11 for engagement within a mating groove on the refrigerator door or refrigerator body.

40 In the construction illustrated in Figure 2, a rectangular seal body 13 is provided and a ferrous metallic strip 15 extends lengthwise of the seal just below the surface of one of the longer faces of the seal. A further ferrous metallic strip 19 is located just below the surface of the opposite face 21 of the seal, the width of the strip 19 being considerably greater than that of the strip 15. By this means the magnetic attraction of the strip 19 is greater than that of the strip 15 if the strips are magnetised to the same degree. It will be appreciated, however, that the magnetic attraction can be altered by changing the size of the strips, or the extent to which they are magnetised, or the distance of the strip beneath the surface of the seal.

60 In an alternative embodiment, the construction shown in Figure 2 can be manufactured without the strip 19 and the face 21 of the seal can then be adhesively secured to the refrigerator door or body.

65 The seal shown in Figure 3 is rectangular in

cross-section, and formed principally of a continuously moulded polyurethane foam 21. A magnetisable metallic strip 23 is located on a longer surface of the foam 21 and a polyethylene film 25 then forms an impervious skin around the seal. 70

75 In the construction shown in Figure 4, a seal for the motor vehicle industry is illustrated. This seal comprises a generally U-shaped extrusion 27 of known construction, for application to a flange around a vehicle door or door opening, and a round, hollow sealing portion 29, e.g. of foam rubber. A magnetic or magnetisable strip 31 is located just below the surface of the portion 29, opposite the extrusion 27. The extrusion 27 can be of rubber or plastics, and may be extruded in one with the portion 29, or the two parts may be adhesively or otherwise connected together. 80

85 By providing the magnetic strip 31, an excellent seal between vehicle body and door can be achieved. Sometimes, because of manufacturing tolerances, an imperfect seal is obtained with known sealing strips. However, the magnetic strip 31 causes the sealing strip to be attracted towards the surface with which it must seal, and since the portion 29 is relatively soft, it can be caused by the magnetised strip 31 to deform very slightly, when necessary, to achieve a seal which might not otherwise have been achieved. 90

95 The embodiment shown in Figure 5 is similar to that of Figure 1, although in this embodiment, a magnetic strip 35 is located on the surface of the seal, and is locked in position in the body 37, (e.g. of PVC) of the seal by two stepped end portions 39. 100

105 In all the embodiments described above, it is necessary for the strips 7, 15, 19, 23, 31 or 39 to be permanently magnetised before the seals can be used. This magnetising operation can be performed in known manner, for example, by passing the seal through a magnetic field either immediately after the extrusion or profile forming operation or at a further work station. It might even be possible to magnetise the strip(s) before the profile forming operation. 110

115 It will be appreciated that the seals illustrated herein and described above would normally be pre-formed, for example, into a rectangle, in known manner to suit the precise shape and face of the refrigerator door, or motor vehicle, or whatever, for which they are designed. This forming operation can be performed either before or after the magnetising operation. 120

125 With the exception of the construction shown in Figure 3, the seals are extruded using our well-established crosshead extruding process.

130 Obviously, it is desirable for the pre-formed metallic strip (which could be a

wire) to be of a permanently magnetisable nature. This can be achieved either by using a high nickel, cobalt alloy of steel or by using ordinary steel which then has a permanently magnetisable material sintered onto, or copper coated and then set onto, the surface of the steel. The whole strip can then be primed with an adhesive system using coil coating techniques in order to improve rubber (or plastics) to metal adhesion during curing after crosshead extruding of the rubber or plastics material over and around the strip.

The material for coating onto the surface of the strip, e.g. by sintering, may be that known under the Trade Mark FREOBAR available from Balfour Darwin of Tinsley, and the material for priming to improve the rubber to metal adhesion may be that known as THIXON AP.1559. (THIXON is a R.T.M.) This is especially suitable for EPDM rubber.

By making our seals in one piece, i.e. the magnetic strip and polymeric material are integral, we can arrange for the gap between the magnetic strip and surface to be sealed to be very small, or zero. The obvious advantage is that we can obtain the same magnetic force of sealing with a weaker magnet than has been used in the past, which has cost and weight advantages.

WHAT WE CLAIM IS:-

1. A seal for sealing against a metal surface such as a refrigerator door, the seal being formed of a resiliently deformable polymeric material which carries a magnetised or magnetisable preformed metallic strip at or adjacent one of its surfaces, the resiliently deformable polymeric material being extruded around the preformed strip so as to be integral therewith.

2. A seal as claimed in claim 1 which is of a generally rectangular cross-section and is suitable for a refrigerator door seal, the strip being totally encapsulated by the polymeric material.

3. A seal as claimed in claim 2 wherein the strip is of a ferrous metal which is located just below the surface.

4. A seal as claimed in claim 1, 2 or 3 wherein the strip is located generally centrally along one of the longer faces of the seal.

5. A seal as claimed in claim 2 wherein the strip is located on one of the longer faces of the seal, the ends of the strip being keyed into the body of polymeric material.

6. A seal as claimed in claim 3, 4 or 5 wherein the opposite face of the seal is especially formed for connection to a surface.

7. A seal as claimed in claim 6 wherein the opposite face has a generally dovetailed configuration for mating engagement in a

re-entrant groove.

8. A seal as claimed in any one of claims 2-7 wherein a further magnetisable metallic strip is located just below the surface of the opposite face of the seal.

9. A seal as claimed in claim 8 wherein said further strip is wider than the first-mentioned strip so that when magnetised it will adhere to a metallic surface with a greater adhesion than the first-mentioned strip.

10. A seal as claimed in claim 1, 2, 3 or 4 which comprises a continuously moulded polyurethane foam surrounded by a synthetic film with a magnetic or magnetisable strip located immediately within the synthetic film, on a surface of the foam.

11. A seal as claimed in claim 1, which is of a type used in the automobile field for sealing around doors in motor vehicles, and comprises a hollow generally circular polymeric extrusion with the magnetisable or magnetised strip adjacent one face of the extrusion, the opposite face of which is connected to a U-shaped gripper for application to a flange around a door opening or door on the motor vehicle.

12. A seal substantially as hereinbefore described with reference to the accompanying drawings.

13. A method of manufacturing a magnetic seal comprising the steps of extruding a resiliently deformable body of polymeric material around a magnetisable metallic strip in such a manner that the metallic strip is located adjacent one peripheral surface of the body, and subsequently magnetising the metallic strip through said polymeric material.

14. A method according to claim 13 comprising the further step of cutting the strip to lengths subsequent to the magnetising step.

15. A method according to claim 13 or 14 wherein the body of polymeric material is generally rectangular with the strip being located centrally along said one peripheral surface of the seal just below the surface.

16. A method according to claim 15 comprising the further step of arranging a second magnetisable strip relative to the body such that the second strip is located just below the opposite surface of the seal during the extrusion operation.

17. A method of manufacturing a magnetic seal substantially as hereinbefore described with reference to the accompanying drawings.

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